DETERMINATION OF PERMISSIBLE OVERLOADS ON DISTRIBUTION TRANSFORMERS

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SUMMARY

This bulletin contains:

1. A method of determining permissible overloads on existing distribution transformer installations.

2. A method of determining the proper size of transformer to be used when peak load and normal load are known.

Determination of
Permissible Overloads on Distribution Transformers

On power systems it is very frequently necessary to allow loading of distribution transformers above their rated loads. In such cases it is necessary to insure that the overlaod will not damage the transformer windings. For this reason, the percentage of permissible overload and the duration of time during which the overload may be applied must be determined.

The problem may be approached from two points of view:

1. An existing installation in which the rating and present load on a transformer are known and it is desired to determine how much additional load may be applied.

2. A case in which a transformer must be installed to take care of a varying load where the peak load, the normal load, and the duration of the peak load are known and it is required to determine the minimum size of transformer which will serve the load.

It is clear that in the first case the following factors will affect the amount of additional load the transformer can carry:

1. The amount of load the transformer carries prior to the application of the overload.

2. The duration of the overload.

3. The ambient temperature. (The temperature of the air surrounding the transformer.)

Chart I is used for calculating the amount of permissible overload for varying durations based on an ambient temperature of 30 C. Chart II is used to obtain a correction factor for other ambient temperatures.

In the second case, the determining factors are:

1. Ratio of normal load to peak load.

2. Duration of peak load.

3. Ambient temperature.

Chart III is used to obtain a transformer rating factor which, multiplied by the peak load determines the size of the transformer to be used. The chart is based on an ambient temperature of 30 C. Chart IV is used to obtain a correction factor for other ambient temperatures.

It must be emphasized that these curves take into account only thermal effects of the overload and determinations made on this basis will insure the protection of transformers from damage due to overheating. However, other limiting factors may be excessive voltage drop and flicker, and these factors should be checked after determination of transformer size or permissible overloads have been made, based only on thermal considerations.

CHART I

PERMISSIBLE OVERLOADS ON DISTRIBUTION TRANSFORMERS

This chart shows the ratio of allowable peak load to rated transformer capacity for varying periods of overload. It is to be used where the allowable overload on an existing installation is to be determined. The chart is not for use with Completely Self Protecting (CSP) Type Transformers equipped with thermal breakers.

1. For overloads up to 5 minutes duration use Curve A.

2. For intermittent overloads of durations from 5 minutes to 8 hours, following a period of no initial load, use Curve B.

3. For intermittent overloads of duration from 5 minutes to 8 hours, following varying initial load conditions, use Curves C, D, E, or F.

To determine initial load conditions:

1. Take the average over a period of 12 hours preceding the peak load.

2. In cases where the peak load occurs at intervals of less than 12 hours, take the average of the loads between peaks.

Example:

Assume a 100-kva transformer bank. It is required to find the percentage of peak overload permissible for a period of 3 hours assuming that the peak follows an initial normal load of 60% rated capacity.

1. Use Curve D for 60% initial load.

2. Against a duration of peak of 3 hours, a peak load of 115% is permissible. 100 x 1.15 = 115 kva is the permissible load on the bank, provided the average daily ambient temperature is 30° C. For other ambient temperatures refer to Chart II for correction factor.

Chart I

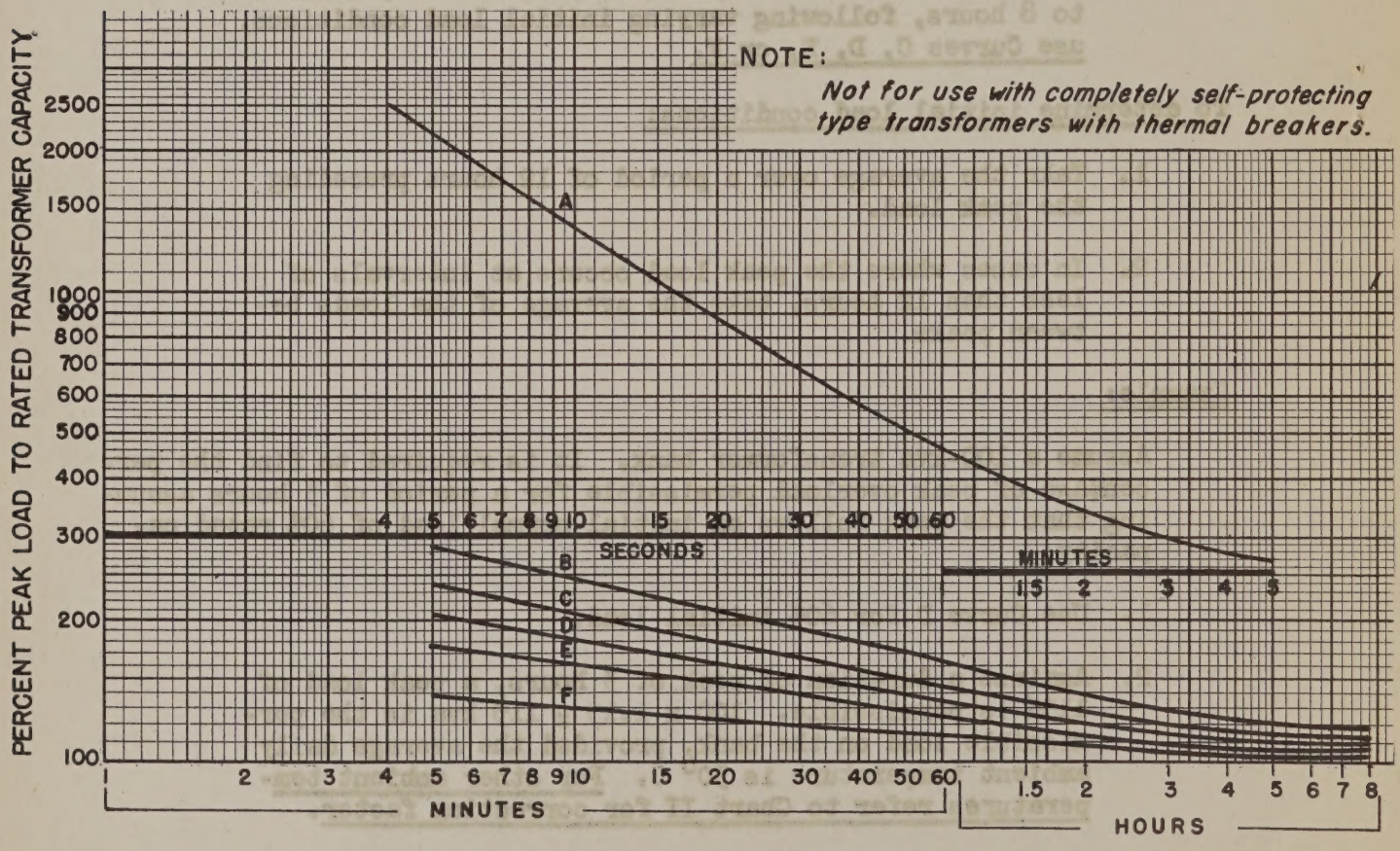
PERMISSIBLE OVERLOADS ON DISTRIBUTION TRANSFORMERS

FOR 30° AMBIENT TEMPERATURE

CURVE	INITIAL LOAD
A	FULL LOAD
B	NO LOAD
C	50 %
D	60 %
E	75 %
F	90 %

REPRODUCED FROM A.I.E.E. TECHNICAL PAPER 39-171
"GUIDE FOR SELECTION OF DISTRIBUTION TRANSFORMER SIZE AS DETERMINED BY LOAD CYCLE REQUIREMENTS"
BY M. F. BEAVER.

NOTE:
Not for use with completely self-protecting type transformers with thermal breakers.



DURATION OF PEAK

CHART II

AMBIENT TEMPERATURE CORRECTION FACTORS FOR USE WITH CHART I

This chart gives the multiplying factor for values of permissible overload found from Chart I, when the temperature differs from 30 degrees Centigrade.

Example:

Suppose the 100-kva bank of the previous example were operated in an ambient temperature of 20 degrees Centigrade.

Use the curve for 20° C and against 115% overload find the correction factor 1.085.

115 x 1.085 = 125 kva, the permissible overload for 3 hours' duration at an ambient temperature of 20° C.

Chart II

AMBIENT TEMPERATURE CORRECTION FACTORS

TO BE USED WITH CHART I FOR AMBIENT TEMPERATURES OTHER THAN 30°C.

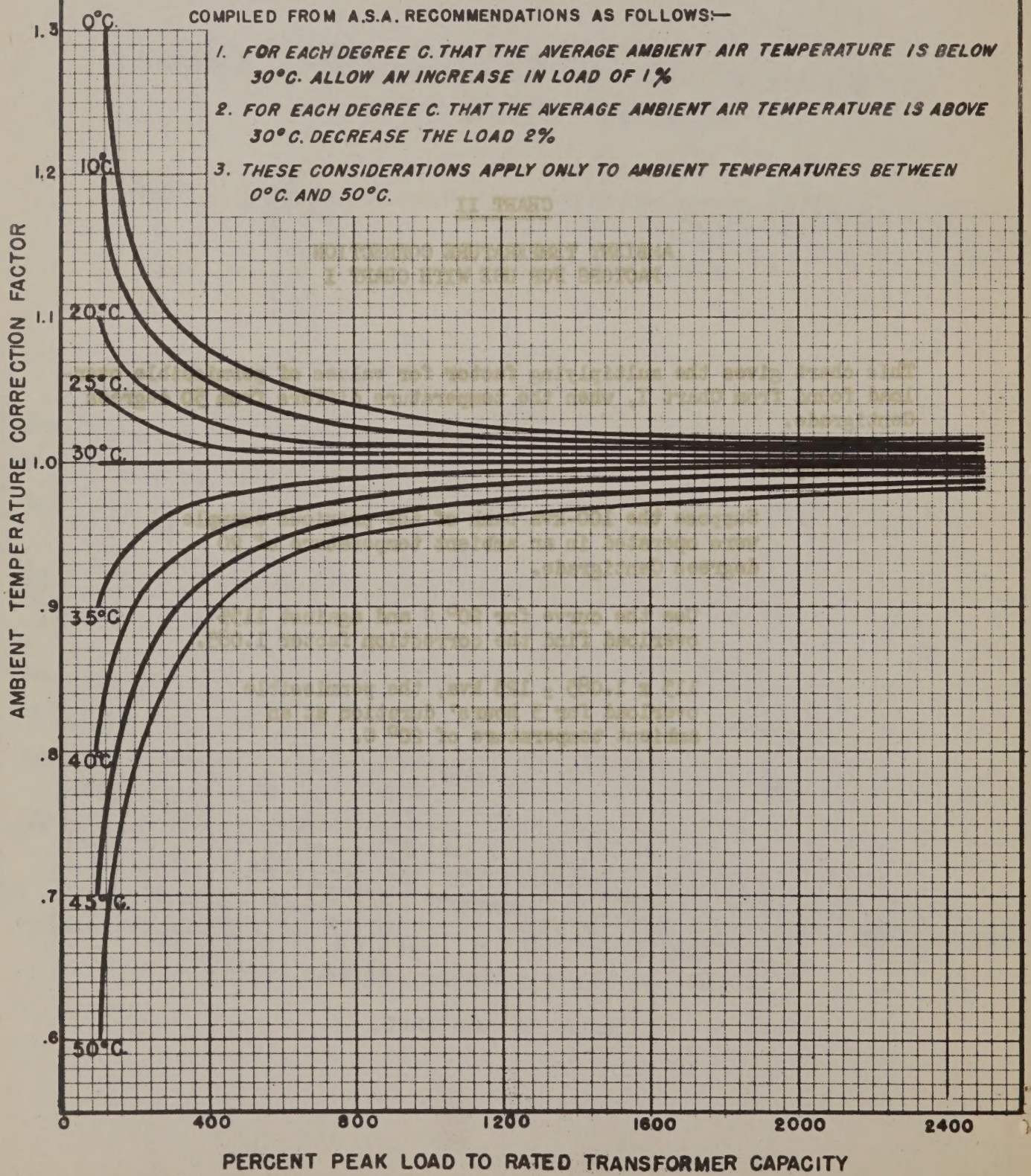


CHART III

TRANSFORMER RATING FACTOR
as a
Function of Equivalent Rectangular Peak Duration and Equivalent Initial Load

This chart is to be used to determine the size of transformer required for an installation when the peak and normal load requirements and the duration of peak load are known.

The chart gives a Transformer Rating Factor, which, multiplied by the peak load, gives the required transformer rating for 30 degrees Centigrade ambient temperature.

The normal load is determined in the same manner as the initial load conditions for Chart I. This chart is not for use with CSP Type transformers equipped with thermal breakers.

Example:

Assume a peak load of 200 kva lasting 3 hours with a normal load of 100 kva.

1. Express the normal load as a percentage of peak load:

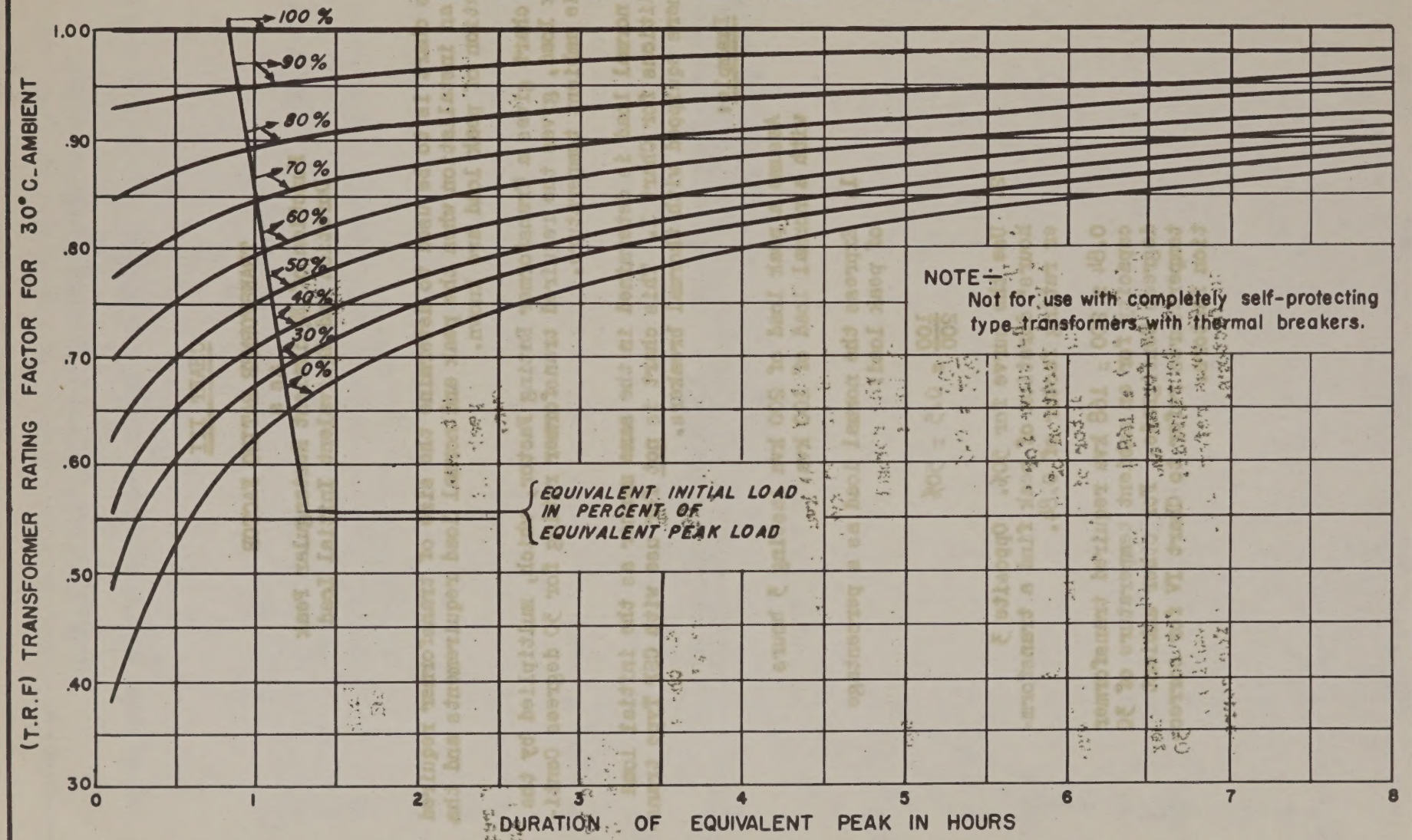
$$\frac{100}{200} = 0.5 = 50\%$$

2. Use the curve for 50%. Opposite 3 hours' duration of peak find a transformer rating factor of 0.84.

   0.84 x 200 = 168 kva required transformer capacity for an ambient temperature of 30 degrees Centigrade. For other ambient temperatures refer to Chart IV for correction factors.

Chart III

TRANSFORMER RATING FACTOR AS A FUNCTION OF EQUIVALENT RECTANGULAR PEAK DURATION AND EQUIVALENT INITIAL LOAD



REPRODUCED FROM ARTICLE APPEARING IN FEBRUARY 1940 ISSUE OF THE GENERAL ELECTRIC REVIEW BY P. L. ALGER, ENTITLED "PROGRESS IN ENGINEERING KNOWLEDGE DURING 1939."

CHART IV

AMBIENT TEMPERATURE CORRECTION FACTORS FOR USE WITH CHART III

This chart gives the multiplying factor for values found in Chart III, for ambient temperatures other than 30 degrees Centigrade.

Example:

Assume the case of the previous example where the ambient temperature is 20 degrees Centigrade.

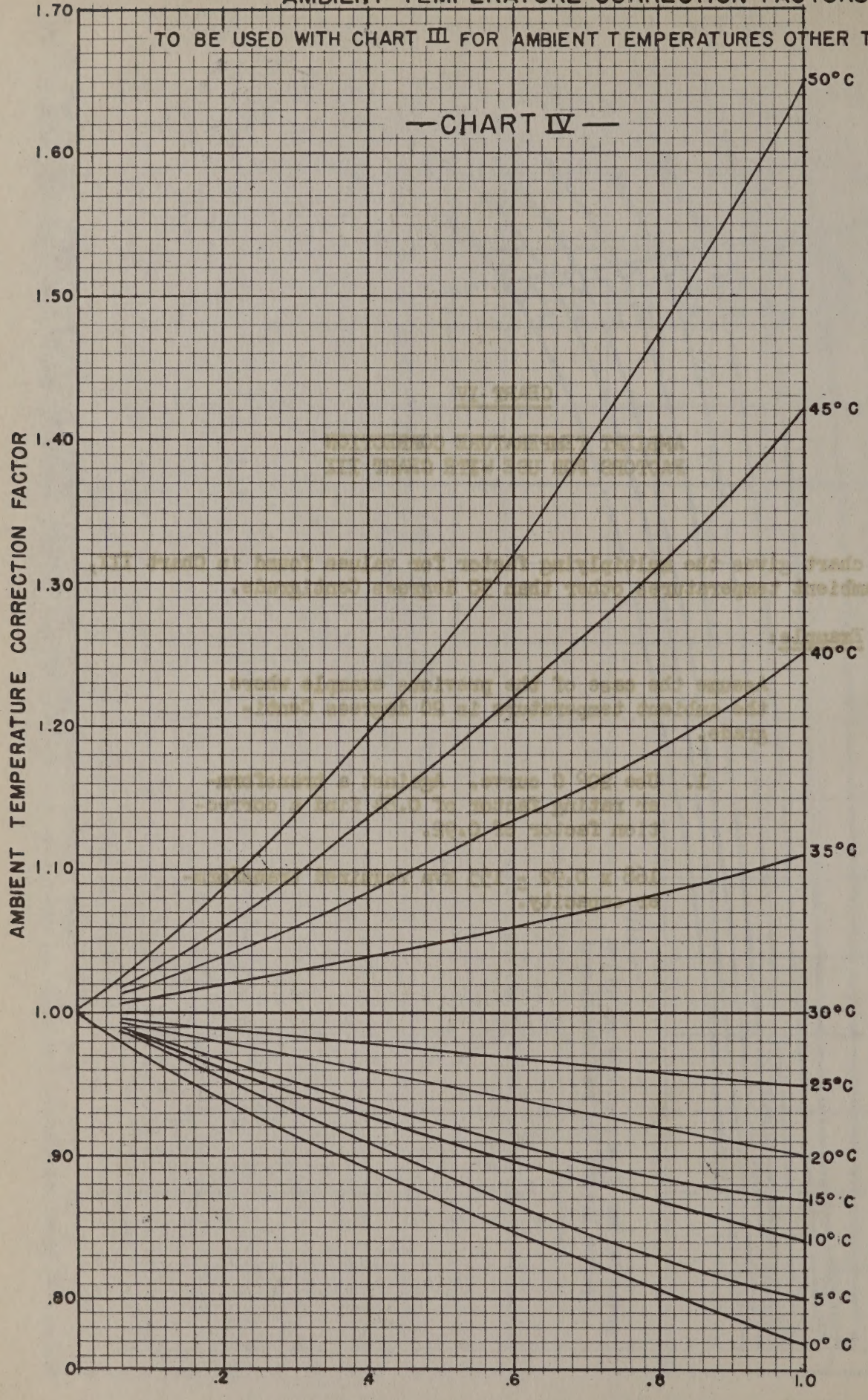
1. Use 20° C curve. Against a transformer rating factor of 0.84 find a correction factor of 0.92.

   168 x 0.92 = 155 kva required transformer capacity.

AMBIENT TEMPERATURE CORRECTION FACTORS

TO BE USED WITH CHART III FOR AMBIENT TEMPERATURES OTHER THAN 30° C.

—CHART IV—



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